SYNCHRONIZING RF SYSTEM

BACKGROUND OF THE INVENTION

1. Field of Invention

[0001] The present invention relates generally to synchronizing Radio Frequency (RF) methods and systems, and more particularly pertains to synchronizing RF methods and systems designed to extend the battery lifetime of battery powered RF receivers, particularly those operating in bands wherein the transmitter duty cycle is restricted.

2. Discussion of the Prior Art

[0002] The technique of transmitting periodic data messages and periodically waking a battery powered receiver to receive the periodic data messages is generally known in the art, and is used in RF communication systems wherein a battery or line powered transmitter transmits periodic messages to a battery powered receiver to extend the battery life in the receiver.

SUMMARY OF INVENTION

[0003] The present invention provides a synchronizing method and system between a Radio Frequency (RF) transmitter and receiver wherein the transmitter transmits short duration first periodic sync signals which are received and used by the receiver to maintain proper synchronization of the receiver with the transmitter during second periodic wake-up windows for transmission of data, such that the receiver will wake and be properly synchronized for possible wake up window data transmissions from the transmitter. The receiver wakes for a short duration at the start of each periodic wake up window to receive a possible transmission of data, and if no transmission is received

goes back to sleep, and if a transmission is received stays awake to receive the full transmission of data. The basic principle is that the average current consumed by the battery powered receiver in order to wake periodically to receive the first periodic sync signals to maintain synchronization and to wake periodically to listen for the possible second periodic data transmissions is less than the average current required to maintain the receiver awake continuously.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] The foregoing objects and advantages of the present invention for a synchronizing RF system may be more readily understood by one skilled in the art with reference to Figure 1 which illustrates one application of the present invention to a security alarm system wherein an AC powered control panel may provide a display of all pertinent parameters and conditions of the security alarm system, and also includes a local RF transmitter which transmits periodic RF messages on the present status of the security alarm system to a plurality of battery powered wireless keypads or Reduced Display Modules (RDMs).

DETAILED DESCRIPTION OF THE INVENTION

[0005] Figure 1 illustrates one application of the present invention in a security alarm system 10, such as an Ademco security alarm system, wherein an AC powered control panel 12, such as an Ademco Quikmate™ control panel, is located within a building protected by the security alarm system. The control panel may provide a local display of all pertinent parameters and conditions of the security alarm system, and may also provide inputs, such as a Graphical User Interface (GUI) 12, to allow a user to enter data into and access and control the security alarm system.

[0006] The control panel can also include a local RF transmitter 16 which transmits over an antenna 18 periodic RF messages from 20 on the present status of the security

alarm system to a plurality of battery powered wireless keypads or Reduced Display Modules (RDMs) 22, only one of which RDM1 is illustrated in detail, provided at a plurality of locations throughout the building. Each battery 24 powered RDM receives the local RF transmissions from the transmitter at the control panel, such that each wireless keypad RDM can also provide an accurate display of the present status of the security alarm system.

[0007] The following represents one designed embodiment of a wireless keypad RDM for use with a system control panel RF transmitter, with a reasonable response time being provided for reporting chime/entry beeps etc.

[0008] The Federal Communications Commission (FCC) in the USA in FCC Rule 15 allows up to 2 seconds of air-time to be transmitted per hour which can be used for the purposes of providing synchronization, polling, supervision etc. This additional 2 seconds does not significantly increase the system clash rate.

[0009] Pursuant to the present invention, these 2 seconds are used by the system control panel RF transmitter to send periodic sync (synchronization) messages from 20 to each battery 24 powered receiver 26 in each RDM 22. The periodicity of the sync messages is determined by the stability of the oscillator crystals in the clocks 28, 30 of the transmitter and receiver. In between the periodic sync messages, the transmitter and receiver are maintained synchronized to transmit/receive second periodic system messages and data from 32 during the same predetermined wake-up data transmission windows.

[0010] The transmitter 16 sends alarm or status messages only at the particular synchronized data transmission wake up windows or ticks. The periodicity of the synchronized data transmission wake up windows or ticks is 3 seconds, assuming that a 3 second response time period is acceptable. Each receiver 26 in each RDM 22 wakes

every three seconds for a very short period of time to listen for any possible transmitter data message.

[0011] Each receiver 26 current is 7mA (5mA Rx, + 0.5mA uP, + 1mA analog + 0.5mA miscellaneous).

[0012] Each receiver needs approximately 8ms to wake up and stabilize and needs approximately 4ms to antenna-switch between diverse antennae and make a stay-awake or return-to-sleep decision. Assuming that a worst case allowable relative time shift between the transmitter and receiver ticks is 2ms, therefore the stability of the oscillator crystals of the clocks in the transmitter and receiver must be such as to ensure 2ms accuracy over the period between sync messages.

[0013] Assuming that the sync message is approximately 88 bits (5 byte preamble, 3 byte site ID, 1 byte message type, 2 byte CRC), i.e. "on" time is 8.8 ms at the preferred data rate. So, to comply with a preferred 2 second per hour target, there can be a maximum of 227 sync messages per hour, i.e. the periodicity is 16 seconds.

[0014] An accuracy of 2ms over 16 seconds is 126ppm maximum, say 60 ppm at the transmitter and 60ppm at the receiver.

[0015] Each receiver 26 average current is 14ms/3s x 7mA = 33uA.

[0016] Assume false starts occur 1 per minute, a false start consumes 20ms, i.e. average 20ms/60s x 7mA = 2.3uA.

[0017] The sync message average current is 20ms/32s x 7mA = 3.5uA.

[0018] Assume a loss of synchronization once per hour, which requires opening the receiver window to four times its normal width to resynchronize, or to transmit a resynchronize request, i.e. average current 80ms/3600 x 7mA = 0.2uA.

[0019] Therefore the total average current is 40uA, i.e. 350mAhr/year.

[0020] Note that in many instances, it may be preferred to transmit more than one sync message contiguously to ensure redundancy against interference or noise, so for example if the message was sent twice, the sync message length would increase to 17.6mSec, and the resultant number of sync transmissions per hour would be 114, with a period of 32 seconds, and a total crystal tolerance of 63ppm, (30ppm in the transmitter and 30ppm in the receiver).

[0021] A AA battery 24 cell capacity is approximately 1.8Ahr, suggesting a possible life for a wireless keypad RDM of approximately 5 years.

[0022] While several embodiments and variations of the present invention for a synchronizing RF system are described in detail herein, it should be apparent that the disclosure and teachings of the present invention will suggest many alternative designs to those skilled in the art.